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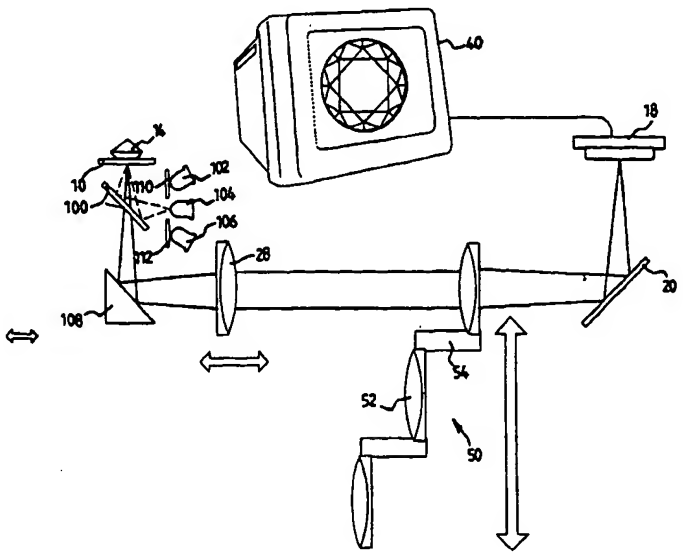

(57) Abstract

The apparatus comprises a viewing stage (not shown) including an antireflection–coated window (10) on which a diamond or gemstone (14) is placed. The diamond or gemstone, which may be a diamond gemstone, is first irradiated by two LEDs (102, 106), having diffuser means (110, 112), the magnification of the viewing system being set at a relatively low level. An image of all or most of at least one facet of the diamond is displayed on the video monitor (40). When the level of magnification is increased, the LEDs (102, 106) are switched off and a central LED (104) is switched on so as to cause the diamond (14) to be irradiated by direct radiation. The position of the diamond (14) is adjusted until a retro–reflection condition is obtained, which allows a mark on the surface of a diamond or gemstone to be viewed.

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Examining Diamonds and Gemstones

Background to the invention

The present invention relates to a method and apparatus for viewing a mark formed on the surface of a diamond or other gemstone and, in particular, to a method and apparatus for viewing indicia or information marks on a polished facet of a gemstone. The invention is of particular interest in viewing marks on gemstone diamonds, although it is envisaged that the diamond could alternatively be an industrial diamond, such as a wire-drawing die.

WO97/03846 describes in detail a method of applying marks to gemstone diamonds in particular, such marks preferably being invisible to the naked eye or even invisible to the eye using a x10 loupe, which is the loupe used by jewellers. The marks are applied by irradiating a diamond gemstone with ultraviolet laser radiation using a projection mask, the nature of the marks being such that they can be applied to a polished facet of a gemstone without detracting from its value or appearance.

The marks may comprise brand marks, identification numbers, or marks conveying other information regarding the gemstone, and it is generally desirable to provide a method and apparatus for viewing such marks quickly and easily, which can be used by jewellers in a retail jewellery shop, as well as diamond dealers, etc.

The Invention

According to a first aspect of the present invention there is provided viewing apparatus for viewing a mark on the surface of a gemstone, comprising irradiation means for irradiating at least a portion of the gemstone, diffuser means for irradiating the

gemstone with diffused radiation, means for irradiating the gemstone with direct radiation, viewer means for producing a first image of at least a portion of said gemstone irradiated with diffused radiation and a second image of at least a portion of said gemstone irradiated with direct radiation, and display means for displaying said first and second images.

Also in accordance with the first aspect of the present invention, there is provided a method of viewing marks on the surface of a diamond or gemstone, comprising the steps of irradiating at least a portion of said gemstone with diffused radiation, irradiating at least a portion of the gemstone with directional radiation, producing a first image of said at least a portion of said gemstone irradiated with diffused radiation and a second image of said at least a portion of said gemstone irradiated with directional radiation, and displaying said first and second images.

For the avoidance of doubt, the term "diffused radiation" is intended to mean radiation which irradiates the diamond or gemstone with radiation at a relatively wide range of angles, for example, a range of angles covering at least 20°. The term "direct radiation", on the other hand, is intended to mean radiation which irradiates the diamond or gemstone with radiation at a relatively narrow range of angles, for example, a range of angles covering not more than 20°, preferably not more than 10°.

The first image is preferably produced at a first level of magnification and the second image is preferably produced at a second level of magnification, the first level of magnification preferably being lower than the second level of magnification, in order to display an image of substantially the whole stone before increasing the level of magnification and changing the manner of illumination, i.e. from diffused radiation to direct radiation, so as to 'reveal' the mark.

In a first embodiment, a 'plate' may be provided which is formed with at least one aperture, for example, in a substantially central location. The plate is positioned in the irradiating path so that the gemstone is irradiated with direct radiation through the

aperture. The diffuser means and the plate can be interchangeable, thereby enabling a relatively small viewing unit to be produced. In other words, the diffuser and the plate can be alternately positioned within the irradiation path. The diffuser may be attached to or formed on the end of the plate having the at least one aperture, so as to form a single optical component.

Any convenient means for changing the magnification may be provided, for example, a rotatable knob having two or more predetermined settings corresponding to two or more respective levels of magnification. In this case, the knob communicates with a rotatable wheel carrying a plurality of peripheral magnification lenses. Rotation of the knob causes rotation of the wheel so as to place the desired magnification lens or lenses in the image path. Alternatively, and more preferably, a linear-sliding lens-changing mechanism capable of introducing variable magnification may be used. This enables the unit to be relatively compact. As further alternatives, a zoom optical arrangement giving a continuous range of magnifications can be used, or a fixed magnification system with an electronically zoomable camera.

In the first embodiment, the means for changing the level of magnification may be linked to the optical component carrying the diffuser and the section formed with an aperture, such that operation of the magnification changer causes longitudinal movement of the optical component so as to place the diffuser in the irradiation path if the level of magnification is decreased, or to place the section formed with at least one aperture in the irradiation path.

The apparatus of the first embodiment of the present invention may include a number of different plates or sections to be placed in the irradiation path. For example, as well as the diffuser, the apparatus may also include a plate having a single, generally central pinhole aperture and a plate having one off-set aperture, or two apertures which are positioned on either side of a generally central position on the plate so as to provide an oblique direct light source or sources to the gemstone. These sections are intended to be interchangeable such that if it is required to view the whole gemstone, the diffuser is

placed in the irradiation path, if it is desired to view the mark on the surface of the gemstone, the level of magnification is increased, and the gemstone is illuminated using one of the direct light sources, the plate having the off-centre aperture or apertures being used to provide an angular or two symmetrical angular light sources to the gemstone for the purpose of revealing a mark which is formed with a plurality of grooves which have a diffractive effect on the light incident thereon, and causing the mark to appear in a particular colour, for example, blue. Two symmetrical angular light sources are preferred to give greater brightness. Alternatively, more than two apertures may be used.

Using the apparatus of the present invention, the gemstone is first viewed at a relatively low level of magnification with a diffuser in the irradiation path, and the position and orientation of the stone are adjusted so as to obtain a suitable view of substantially the whole crown (or other marked portion) of the gemstone. The appearance of the gemstone closely resembles that under normal retail lighting conditions, simply magnified, and allows the customer both to examine the workmanship of the stone and to be reassured that it is actually the selected stone which appears on the viewer. However, with diffused illumination, the mark is generally impossible to see and locate (due to its "invisibility").

Therefore, the level of magnification is increased, and, in the first embodiment, the diffuser is replaced by a pinhole aperture. The tilt of the table or other facet of the gemstone being viewed is then adjusted so as to obtain retro-reflection from the table or facet. Retro-reflection means radiation which is reflected back along the irradiation path. In these circumstances, the table or facet appears bright and the mark appears as a dark patch, thereby revealing the existence and position of the mark to the user.

The mark can then be positioned in a substantially central viewing position and the magnification may be further increased so that the mark can be read if necessary.

The means for irradiating the gemstone preferably comprises one or more light sources such as light emitting diodes (LEDs) because of the necessity for reliability: LEDs generally have a much longer lifetime than conventional light bulbs. The irradiating means is most preferably one or more white LEDs so that if a colour camera is used to view the gemstone, the image is not influenced by the colour of the LEDs and a realistic image of the facet is achieved. The irradiation path should be substantially normal to the gemstone facet or table being viewed. In the first embodiment, the single LED is positioned directly below the facet or table being viewed. A prism beamsplitter is placed in the irradiation path which allows incident radiation to reach the facet or table being viewed, but directs radiation reflected from the facet or table to the focusing and viewing means at substantially 90° to the direction of incident radiation.

In a second embodiment, a first LED is positioned at substantially 90° to the direction at which it is required to irradiate the facet or table being viewed. The direct radiation from the first LED is incident on a plate beamsplitter positioned in the irradiation path, and is directed at substantially 90° to the facet or table being viewed. Thus, once again, the diamond or gemstone is irradiated from below. Two further LEDs are provided on either side of the first LED, and are angled inwards (towards the first LED, at an angle of, for example, around 45°. The two additional LEDs are each provided with diffuser plates. The first LED may be provided with a cover having an aperture therein to further directionalise the incident radiation. When it is required to irradiate the gemstone or diamond with direct radiation, the first (or central) LED is switched on, and the other two LEDs are off. When diffused radiation is required, the first LED is switched off, and the other two LEDs are switched on. Radiation reflected back from the diamond or gemstone passes through the plate beamsplitter, and is reflected by a prism to the focusing and viewing means.

Thus, the gemstone facet or table of interest may be irradiated through a prism beamsplitter, or, more preferably via a plate beamsplitter.

The viewing means is preferably a camera which is connected to a video monitor or screen for displaying an image of at least a portion of the gemstone being viewed. The screen is preferably provided within the same housing as all of the other components, so as to form a single, compact, portable unit. In a preferred embodiment, the video monitor may be a thin LCD display monitor so that the whole unit can be even more compact and can easily be carried or manipulated.

In accordance with a second aspect of the present invention, there is provided an apparatus for viewing marks on the surface of a gemstone or diamond, comprising a housing including irradiating means for irradiating at least a portion of said gemstone, viewing means for producing an image of at least a portion of said gemstone and a display screen for displaying at least a portion of said gemstone, all of said irradiating means, said viewing means and said display screen being held within said housing.

The display screen may be a liquid crystal display, a monitor screen or video monitor. The image displayed may be monochrome, or more preferably, in colour.

The method and apparatus of the present invention can be used for quickly and simply viewing marks on loose gemstones or on stones, particularly diamonds, mounted in jewellery. Furthermore, the apparatus of the present invention can be compact and extremely portable, as well as robust. This is further compounded by the fact that the apparatus of the present invention requires only a low voltage power supply, for example, between 12 and 24 volts, which may be supplied from the mains via an adaptor or even by means of batteries.

The apparatus of the second aspect of the present invention preferably includes the features of the first aspect of the present invention, thus providing a compact and robust viewing unit which may be used to display to the user an image of a gemstone at a relatively low magnification, such that the complete stone can be inspected by, for example, a prospective customer, and then to increase the magnification and alter the

manner in which the gemstone is illuminated so as to display the portion of the gemstone carrying the 'invisible' mark.

Preferred Embodiment

An embodiment of the present invention will now be described by way of example only and with reference to the accompanying drawings in which:

Figure 1 is a schematic diagram of a viewing apparatus according to a first embodiment of the present invention;

Figure 2 is a schematic diagram of the apparatus of Figure 1, having alternative magnification-changing means;

Figure 3 is a schematic diagram of a second embodiment of the present invention;

Figure 4 is a perspective front view of a viewing apparatus according to the present invention; and

Figure 5 is the apparatus of Figure 4, with the holding arm being in a position suitable for use thereof.

With reference to Figure 1 of the drawing, the apparatus comprises a viewing stage (not shown) for supporting or holding a gemstone, including an antireflection-coated window 10. The viewing stage may comprise a generally flat 'seat' which is mounted in the apparatus by means of a relatively slack gimbal joint which can be manually tilted or rocked in all directions and remains in position when released. Some linear movement may also be possible. The antireflection window 10 comprises a small, substantially transparent piece of glass, each side of which is coated with an antireflection coating, such that the irradiating beam is not reflected back by the window. The window 10 is preferably removably mounted within an aperture in the viewing stage. Alternatively, a separate mounting piece for receiving the window may be provided, the mounting piece being removably mounted in or on the viewing stage. The antireflection window 10 is intended to be disposable so that it can be replaced if it is damaged or it becomes dirty through use.

An LED 12 is provided for irradiating at least a portion of the gemstone 14 through a prism beamsplitter 16.

The gemstone is viewed by means of a charge coupled device (CCD) board camera 18 which receives an image of the gemstone facet being viewed via the prism beamsplitter 16 and a mirror 20. The magnification of the received image can be altered by means of a rotatable magnification changer 22 comprising a plurality of opposing pairs of magnification lenses 24a, 24b equally spaced around the periphery of a generally circular rotatable wheel 26. Rotation of the wheel 26 enables the required magnification lenses 24a, 24b to be placed in the path between the camera 18 and the prism beamsplitter 16 such that the required magnification of the image is achieved. A focusing lens 28 may also be provided in the image path between the magnification changer 22 and the beamsplitter 16, the focusing lens 28 being moveable in the directions shown so as to increase the resolution of the received image. Additional moveable magnification lenses 30, 32 are also provided in the present embodiment, the lenses being located in the image path on either side of the mirror 20 and being moveable into and out of the image path as required.

The apparatus is provided with a diffuser 36 and a pinhole aperture 38 which are interchangeable. (In Figures 1, 2 and 3 the size of the pinhole aperture and the angular width of the beam have been exaggerated.) In the embodiment shown, the diffuser 36 and the aperture 38 are formed on a single moveable plate 34 in the irradiation path between the beamsplitter 16 and the LED 12. It is envisaged that the plate 34 may include one or more further sections (not shown) with different arrangements of apertures.

Thus, as mentioned above, if the mark is provided with a plurality of grooves which have a diffractive effect on radiation incident thereon, then a section including an off-centre aperture or two apertures on either side of a generally central position of the section may be provided. In this case, the one or two pinhole apertures placed in the

irradiation path effectively produce one or two angular light sources to the gemstone. The angle of the light source or sources (i.e. the position of the aperture or apertures) is chosen according to the colour which the mark is required to appear. Thus, if it is required to reveal the mark in blue, the aperture or apertures are positioned such that the angle of the resultant incident radiation corresponds to blue diffracted light. Similarly, the angle of the resultant directional light source or sources could be arranged to correspond to red diffracted light, such that that the revealed mark appears to be red. It will be understood that, in order to set the colour of the mark, it is also necessary to know the distance between the grooves in the mark. However, if this is known, it is envisaged that a number of different angular directional light sources could be made available by providing a number of different sections, each having one off-centre aperture or two apertures positioned on either side of a generally central position, with the holes of each section being positioned according to the colour which the mark is required to appear. Thus, the user could choose the colour in which the mark will appear to the customer.

A video monitor 40 is connected to the camera 18 for displaying the image(s) received by the camera.

In use, a gemstone 14 is positioned on the viewing stage (not shown) with its marked facet against the antireflection coated window 10. Various interchangeable holders may be attached to the viewing stage to receive a loose stone or various different types of jewellery, for example, a ring, necklace, bracelet, etc. For example, a ring holder (not shown) may be provided, comprising a cylindrical-shaped horizontal member which is mounted above the viewing stage such that a ring can be supported above the antireflection window 10 on the cylindrical or bar-shaped member, with its stone facing downwards. A bracket or stirrup may also be provided on which a necklace or bracelet may be draped such that the stone(s) thereof can be inspected.

It is preferred that the gemstone or piece of jewellery is placed in a table down position on the window (if the mark is on the table) to increase ease of location of the stone and

ensure that retro-reflection is quickly established. However, an alternative arrangement could be used.

The marked facet is illuminated through the prism beamsplitter 16 by the LED 12, the irradiation path being substantially normal to the table or other facet being viewed.

The gemstone 14 is first viewed at a relatively low level magnification with the diffuser 36 in the irradiation path. The position and orientation of the stone 14 are adjusted, and the focusing lens 28 is also adjusted as necessary so that the table or other marked facet can be viewed on the video monitor 40. However, with diffused irradiation, the mark is impossible to see and locate.

Therefore, the magnification is increased by rotating the wheel 26 so as to change the pair of magnification lenses 24a, 24b which is positioned in the image path to lenses having a greater magnification quality. The diffuser 36 is replaced by the pinhole aperture 38. In a preferred embodiment, the magnification changer 22 and the plate 34 carrying the diffuser 36 and the pinhole aperture 38 co-operate with each other in such a way that rotation of the magnification changer 22 causes the plate 34 to move in a longitudinal direction so as to replace the diffuser 36 with the pinhole aperture 38 in the irradiation path, or vice versa. Rotation of the magnification changer 22 may also cause the moveable magnification lenses 30, 32 to move into (or out of) the image path as required.

The tilt of the table or other facet being viewed is adjusted by manually tilting, rocking or otherwise moving the viewing stage to obtain retro-reflection from the table or facet, such that the table or facet appears bright while the mark appears as a dark patch, thereby identifying the existence and position of the mark to the user.

Once identified, the image of the mark can be centred on the video monitor 40 by linear movement of the viewing stage, and the magnification may be increased further such that the mark can be read.

With reference to Figure 2 of the drawings, a linear sliding magnification-changing means 50 is provided instead of the rotating arrangement 22 shown in Figure 1. The magnification-changing means 50 comprises a plurality of lenses 52 having different levels of magnification. The lenses are provided on a linear sliding base 54, which can be moved by a user by means of a lever (not shown) which is accessible outside the viewing apparatus. With the sliding magnification changing mechanism, it is possible to make the overall unit more compact than with the rotating arrangement shown in Figure 1.

Referring to Figure 3 of the drawings, a second embodiment of the viewing apparatus of the present invention is very similar in many respects to the first embodiment of the invention, and the same reference numbers are used for like components. The main difference between the first and second embodiments, is the use in the second embodiment of a plate beamsplitter 100, instead of a prism beamsplitter, and the position of the light source(s). Another significant difference is that the plate 34 having the diffuser screen 36 and aperture 38 is omitted in the second embodiment.

In the embodiment of Figure 3, three LEDs 102, 104, 106 are provided, with the plate beamsplitter 100 being placed so as to direct radiation from the LEDs orthogonally upwards to the diamond 14. Radiation reflected from the diamond 14 passes through the beamsplitter 100 to a prism 108 which directs the light orthogonally to the viewing means.

The central LED 104 is intended to irradiate the diamond 14 with direct radiation, and a cover having an aperture formed therein (not shown) may be provided to restrict the angular spread of the radiation. The other two LEDs 102, 106 are angled inwardly towards the central LED 104, as shown, and each of these two LEDs 102, 106 is provided with a diffuser 110, 112.

Operation of the apparatus according to the second embodiment is essentially the same as operation of the first embodiment. However, during the stage where the diamond 14 LEDs 102, 106 are off. When it is required to irradiate the diamond 14 with diffused radiation, the central LED 104 is switched off, and the other two LEDs 102, 106 are switched on.

The advantage of using a plate beamsplitter, as in the second embodiment, instead of a prism beamsplitter is that it eliminates degradation of the image caused by spurious internally reflected light.

Referring to Figures 4 and 5 of the drawings, the viewing apparatus of the first or second embodiments of the present invention may be housed within a single unit 150 comprising a base portion 152 and a lid 154 hinged along one edge of the base portion 152. A screen 156 is provided within the lid 154 so as to lie substantially flush with the inner surface thereof. In one embodiment, the screen 156 may be pivotable along at least one axis, but in a preferred embodiment, the screen 156 is fixed, and a turntable (not shown) is provided on the lower surface of the base portion 152, so that the whole unit can be easily rotated.

An on/off switch or button 158 is provided in the base portion 152. It is also possible to provide means (not shown) for adjusting the colour, contrast and brightness of the viewed image. Such adjustment means can be provided in the base portion 152 or in the lid 154, beside the screen 156.

External magnification changing means 160 is provided in the base portion 152 and external focusing means 162 is also provided.

The viewing stage 164 is mounted on the base portion 152 so that it can be manually rocked or tilted to adjust the position of the diamond 14, when the apparatus is in use. The viewing stage 164 includes a rotatable plate 165 so that the orientation of the

diamond or gemstone being examined can be altered. The rotatable plate 165 carries the anti-reflection coated window 10.

The viewing stage 164 is provided with a clasp 166 which is hinged thereto and spring biased downwards so that, in use, it can be lifted to place a piece of jewellry (not shown) on the anti-reflection window 10, and then released so that it exerts a downward pressure on the diamond to be examined and holds it in place. The facet or table to be examined should be held substantially parallel to the plane of the anti-reflection window 10.

Another means for holding a piece of jewellry in position is provided in the form of an arm 170 which is pivotably mounted on the viewing stage 164 so that when it is not being used it can lie flat against the viewing stage, as shown in Figure 4, and can be pivoted to a substantially vertical position for use, as shown in Figure 5. The arm, is provided with a clasp 172 for gripping a piece of jewellry or gemstone to hold it in position. The aim, once again, is for the surface of the gemstone to be examined to be substantially parallel to the anti-reflection window 10.

The present invention has been described above purely by way of example, and modifications can be made within the spirit of the invention, which extends to the equivalents of the features described. The invention also consists in any individual features described or implicit herein or shown or implicit in the drawings or any combination of any such features or any generalisation of any such features or combination.

Although the present invention is primarily intended to examine gemstones, and in particular diamond gemstones, it is also suitable for examining industrial diamond.

CLAIMS:

1. Viewing apparatus for viewing a mark on the surface of a diamond or gemstone, comprising irradiation means for irradiating at least a portion of the diamond or gemstone, diffuser means for irradiating the diamond or gemstone with diffused radiation, means for irradiating the diamond or gemstone with direct radiation, viewer means for producing a first image of at least a portion of said diamond or gemstone irradiated with diffused radiation and a second image of at least a portion of said diamond or gemstone irradiated with direct radiation, and display means for displaying said first and second images.

2. Viewing apparatus according to claim 1 comprising a plate beamsplitter for directing radiation from said irradiation means to the surface of said diamond or gemstone to be viewed.

3. Viewing apparatus according to claim 1 or claim 2, comprising a first irradiation means for irradiating said diamond or gemstone with direct radiation.

4. Viewing apparatus according to claim 3, comprising an opaque screen, positioned within the irradiation path of said first irradiation means, said screen having an aperture formed therein, such that, in use, the diamond or gemstone is irradiated through said aperture.

5. Viewing apparatus according to claim 3 or claim 4, comprising second irradiation means for irradiating said diamond or gemstone with diffused radiation.

6. Viewing apparatus according to claim 5, wherein said second irradiation means comprises at least two irradiation sources, the sources being angled such that their irradiation paths overlap at least partially.

7. Viewing apparatus according to claim 6, wherein each of said sources is provided with diffuser means.

8. Viewing apparatus according to any one of claims 2 to 7, arranged such that said second irradiation means is off when said first irradiation means is on, and said first irradiation means is off when said second irradiation means is on.

9. Viewing apparatus according to claim 1, wherein the means for irradiating the diamond or gemstone with direct radiation comprises an opaque screen which is formed with at least one aperture, said screen being positioned within the irradiation path, in use, such that the diamond or gemstone is irradiated through said aperture.

10. Viewing apparatus according to claim 9, wherein said screen is formed with a single, generally central aperture.

11. Viewing apparatus according to claim 9, wherein said screen is formed with two apertures which are located in the screen on either side of a generally central position thereof.

12. Viewing apparatus according to claim 9, wherein said screen is formed with a single, off-centre aperture.

13. Viewing apparatus according to claim 1, wherein said means for irradiating the diamond or gemstone with direct radiation comprises a screen according to claim 10, a screen according to claim 11, and/or a screen according to claim 12.

14. Viewing apparatus according to any one of claims 9 to 13, wherein said screen comprises a plurality of apertures.

15. Viewing apparatus according to any preceding claim, wherein said means for irradiating the diamond or gemstone with diffused radiation and said means for irradiating the diamond or gemstone with direct radiation are interchangeable.

16. Viewing apparatus according to any preceding claim, comprising means for changing the level of magnification, at which said diamond or gemstone is viewed.

17. Viewing apparatus according to claim 16, wherein said means for changing the level of magnification comprises a rotatable wheel having a plurality of peripheral magnification lenses.

18. Viewing apparatus according to claim 16, wherein said means for changing the level of magnification is a zoom magnification system.

19. Viewing apparatus according to claim 18, wherein said zoom magnification system comprises a zoom optical arrangement for providing a continuous range of magnifications.

20. Viewing apparatus according to claim 18, wherein said zoom magnification system comprises a fixed magnification system with an electronically zoomable camera.

21. Viewing apparatus according to claim 16, wherein said means for changing the level of magnification is a linear sliding-lens mechanism, comprising a plurality of magnification lenses.

22. Viewing apparatus according to any one of claims 16 to 21, wherein said means for changing the level of magnification communicates with the means for irradiating the diamond or gemstone with diffused radiation and the means for irradiating the diamond or gemstone with direct radiation, thereby operating said respective means when the magnification is changed to a predetermined level.

23. Viewing apparatus according to any preceding claim, comprising a viewing stage, at least a portion of which includes a transparent window on or above which the diamond or gemstone to be viewed can be placed.

24. Viewing apparatus according to claim 25, wherein at least the underside of said transparent window is coated with an antireflection substance.

25. Viewing apparatus according to claim 23 or claim 24, wherein said viewing stage is mounted by means of a gimbal, such that the viewing stage can be tilted and moved in use.

26. Viewing apparatus according to any one of claims 23 to 25, wherein said viewing stage includes a rotatable plate so that the orientation of the diamond or gemstone being viewed can be altered.

27. Viewing apparatus according to any preceding claim comprising means for holding said diamond or gemstone.

28. Viewing apparatus according to any preceding claim wherein said irradiation means comprises one or more light emitting diodes.

29. Viewing apparatus according to claim 28, wherein said irradiation means comprises one or more white light emitting diodes.

30. Viewing apparatus according to any preceding claim, wherein said viewing means comprises a camera.

31. Viewing apparatus according to claim 30, wherein said camera is a CCD board camera.

32. Viewing apparatus according to any preceding claim, wherein said display means comprises a video monitor,

33. Viewing apparatus according to claim 32, wherein said video monitor is a thin LCD display monitor.

34. Viewing apparatus according to any preceding claim, wherein all of the claimed elements of the apparatus are included in a single housing.

35. Viewing apparatus according to claim 34, wherein said housing includes a cover attached to a base, the display means being mounted in said cover.

36. Viewing apparatus according to claim 35, wherein said display means is rotatable relative to said housing.

37. Viewing apparatus according to claim 35, comprising a turntable on the bottom surface of the housing such that said housing is rotatable relative to the surface on which it stands.

38. A method of viewing marks on the surface of a diamond or gemstone, comprising the steps of irradiating at least a portion of said diamond or gemstone with diffused radiation, irradiating at least a portion of the diamond or gemstone with direct radiation, producing a first image of said at least a portion of said diamond or gemstone irradiated with diffused radiation and a second image of said at least a portion of said diamond or gemstone irradiated with direct radiation, and displaying said first and second images.

39. A method according to claim 38, wherein the steps of irradiating the diamond or gemstone with diffused radiation and irradiating the diamond or gemstone with direct radiation are interchangeable.

40. A method according to claim 38 or claim 39, comprising the steps of irradiating the diamond or gemstone with diffused radiation and displaying substantially all of at least one facet of the diamond or gemstone on said display means, irradiating the diamond or gemstone with direct radiation, adjusting the position of the diamond or gemstone relative to the irradiation path to obtain a retro-reflection condition and displaying at least a portion of said facet on the display means.

41. A method according to claim 40, wherein the diamond or gemstone is located on a moveable viewing stage, the position of the diamond or gemstone relative to the irradiation path being adjusted by moving said viewing stage.

42. A method or apparatus according to any preceding claim wherein said first image is produced at a first level of magnification, and said second image is produced at a second level of magnification.

43. A method or apparatus according to claim 42, wherein said first level of magnification is lower than said second level of magnification.

44. A method of viewing marks on the surface of a diamond or gemstone substantially as hereinbefore described with reference to the accompanying drawings.

45. An apparatus for viewing marks on the surface of a diamond or gemstone, comprising a housing including irradiating means for irradiating at least a portion of said diamond or gemstone, viewing means for producing an image of at least a portion of said diamond or gemstone and a display screen for displaying at least a portion of said diamond or gemstone, all of said irradiating means, said viewing means and said display screen being held within said housing.

46. An apparatus according to claim 45, wherein said display screen is a liquid crystal display, a monitor screen or a video monitor.

47. An apparatus according to claim 45 or claim 46, wherein said housing comprises a base and a cover attached to the base, the screen being mounted on or in said cover.

48. An apparatus according to claim 47, wherein said screen is rotatable relative to said housing.

49. An apparatus according to any one of claims 44 to 47, comprising a turntable on the lower surface of the housing such that the housing is rotatable relative to the surface on which it stands.

50. An apparatus according to claim 45 or claim 46, including the apparatus of any one of claims 1 to 37.

51. An apparatus according to any one of claims 45 to 50, comprising a 12 volt power supply.

52. An apparatus according to any one of claims 44 to 51, comprising a battery power supply.

53. An apparatus according to any one of claims 1 to 37 or claims 45 to 52, wherein said gemstone is a diamond gemstone.

54. A method according to any one of claims 38 to 44, wherein said gemstone is a diamond gemstone.

55. A viewing apparatus substantially as hereinbefore described with reference to the accompanying drawings.

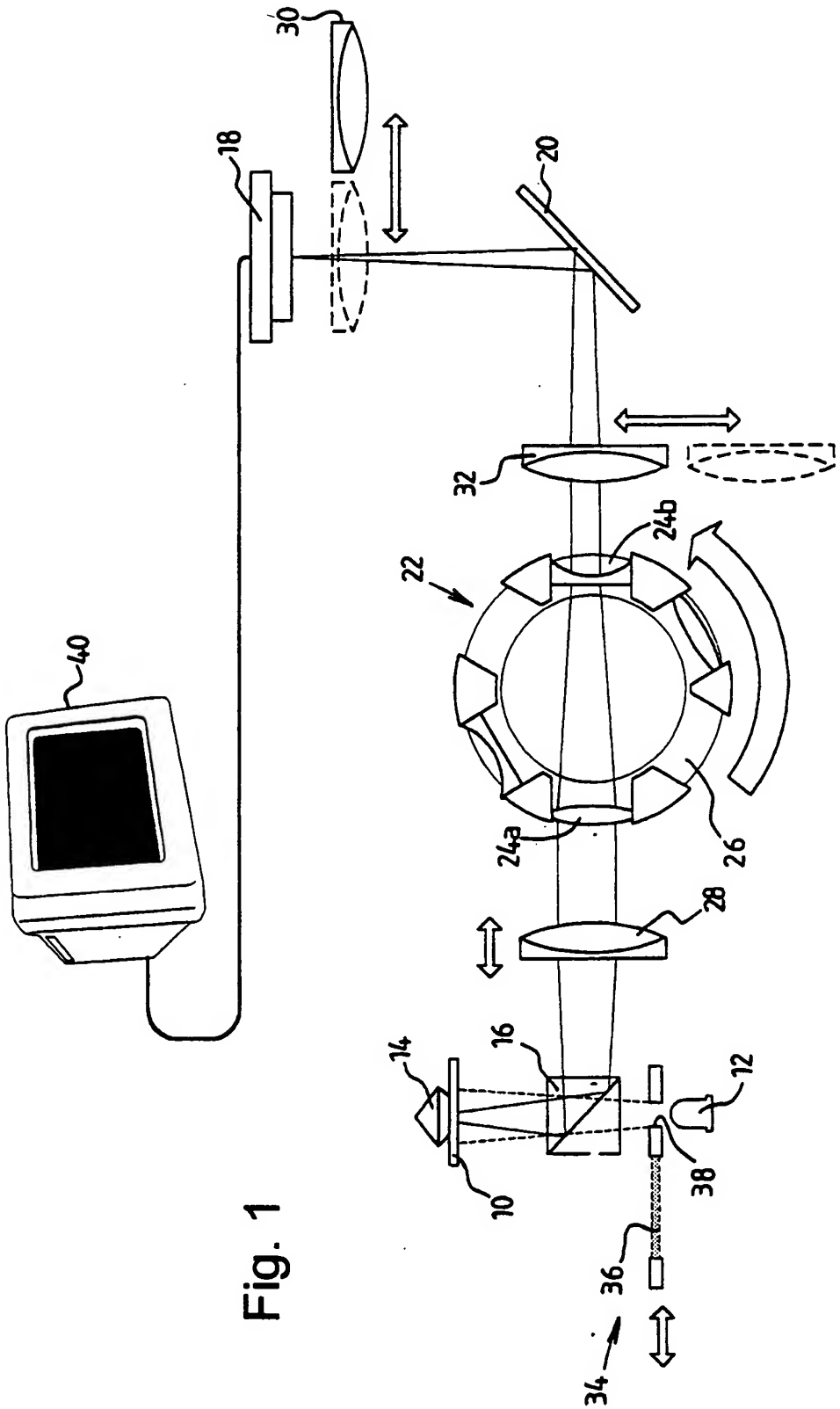

Fig. 1

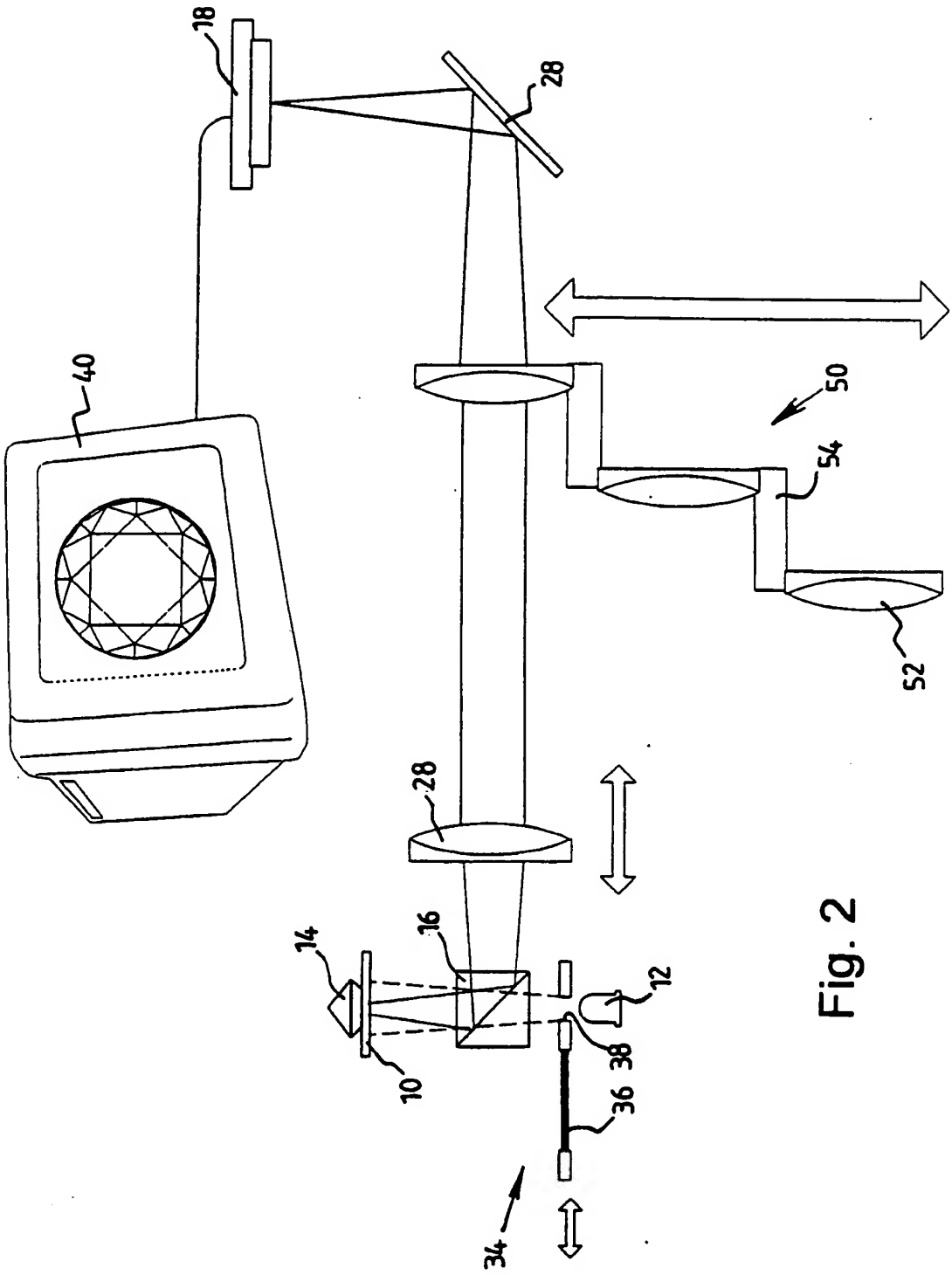

Fig. 2

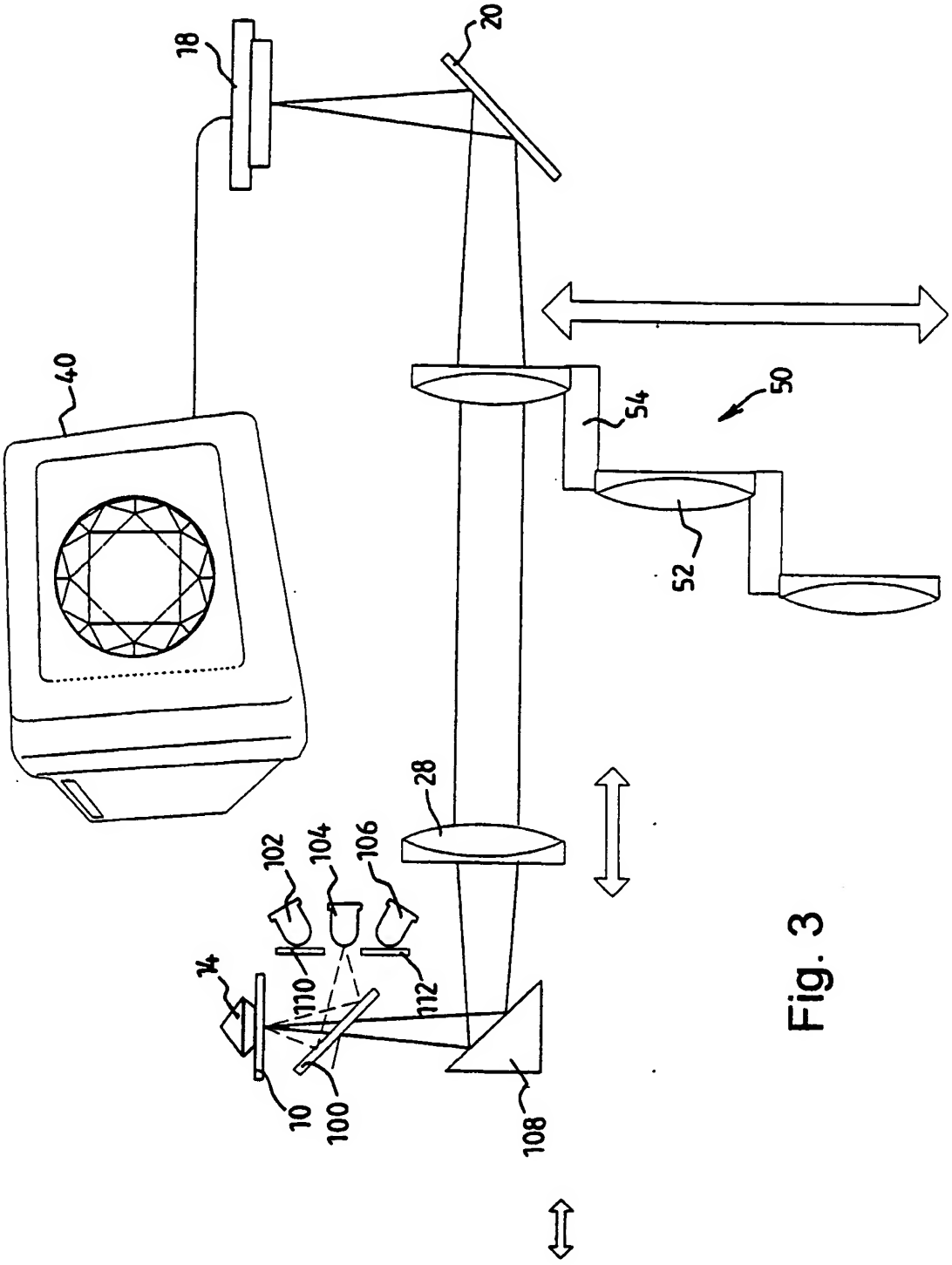

Fig. 3

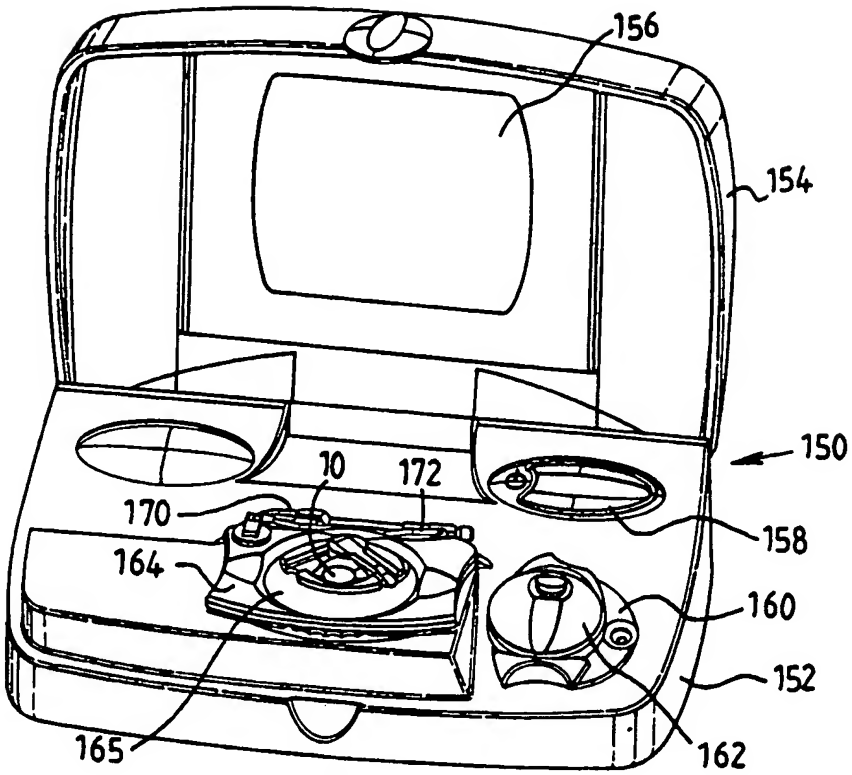
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Fig. 4

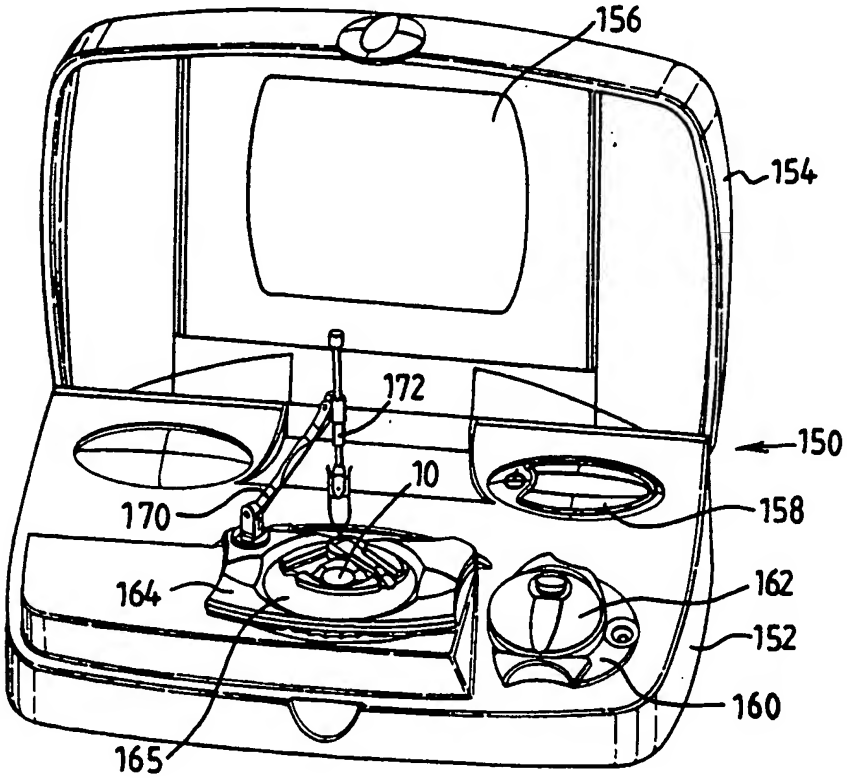
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Fig. 5